

To: Tim Drexler
From: Mark Hutson
Charles Norris
Date: September 21, 2007

Subject: Larry Jensen's Radiological Data Review

Several of the comments and questions provided by Larry Jensen on the radiological aspects of the Yard 520 site characterization bring up issues that need clarification from USEPA. The questions/comments are provided below.

Analytical Methodology – The test does not describe analytical methods. When samples were received at a lab were they dried or were samples analyzed as they arrived? Wet samples will result in a lower measured concentration. What method was used for analysis (gamma spectroscopy, radiochemistry, fluoroscopy, something else?)? The quality of data will depend upon the method. What were the detection limits? Generally, detection limits should have been low enough to measure background levels. If the detection limits were too high the usability of the data may be lost.

Were two aliquots taken from the same sample and both measured (for quality control)? Were there samples measured and then the same sample measured (for quality control)? The report text does not discuss duplicates. Table 4 shows a duplicate for GP008 but does not describe the type of duplicate.

Background Measurements - Background data should have been taken from additional samples in the vicinity of Yard 520. The fundamental strategy for background samples is to select collection sites where the soil is as nearly like the soil of concern but assuredly without any contamination. Use of a national average background is inappropriate because local backgrounds can vary higher or lower. Inappropriate backgrounds can lead to either false positive or false negative conclusions.

That said, data in Table 6 under Background is reasonable for common soils and rocks.

Data Quality Judgements - Most data in Table 4 is to three digits. However, some data is only to two digits (e.g., Uranium-234 for GP008) or to one digit (e.g., Actinium-227 for GP009). My feeling is that all this data was originally expressed with three digits but was inadvertently rounded to less on the spreadsheet. Data in Table 4 should be reported to the digits reported from the lab.

For background soils, and contaminated soils containing unprocessed natural radionuclides, one fundamental way to judge if the data has been analyzed well is to review the data and see if the concentrations for each of the three natural radiation series, Uranium (U-238), Thorium (Th-232) and Actinium (U-235) are in equilibrium (each radionuclide concentration in the series has the same

GEO-HYDRO, INC

numerical value.) Data for GP004-GP013 were grouped by series and are shown in attached Table 1. Some data is acceptable (e.g., Th-232 Decay Series for GP005 which varies from 2.56 – 2.63 picocuries per gram (pCi/g)) and some data is of low quality (e.g., U-238 Decay Series for GP009 which varies from 4.77- 6.81 pCi/g).

Section 4.1.1 Background Evaluation – The closing statement “...radionuclide concentrations present in CCBs collected from Yard 520 are generally within the range of background levels present in the environment” is not supported by the data in table 4 and Table 5. This data was combined in the attached Table 1 where it can be seen that GP004-GP013 data (Table 4) has a range of about 2-7 times background (Table 5).

Section 4.1.2 Human Health Risk Screen Results – USEPA Region 5 has done risk assessments for radionuclides. These have been done by multiplying USEPA risk-concentration factors for individual radionuclides (from Federal Radiation Guidance documents) times the measured concentration (less background), adding all risks, and comparing these to the Superfund (National Contingency Plan) risk range of 10^{-6} to 10^{-4} . Risk found this way is excess risk, which is the proper focus for risk decisions. That process should be applied to this data set. In this way, there will be no need to convert risk to annual dose for comparison to the 15 millirem/year dose guideline.

Risks should not be judged for individual radionuclides but by the summed risk for all radionuclides present.

Also, for cleanups, USEPA Region 5 has largely relied upon the total radium standards in Title 40, Part 192 of the Code of Federal Regulations where 5 pCi/g plus background is used as the cleanup criterion for successive 15 centimeter depths below ground. Total radium is defined as the concentration for radium-226 plus the concentration for radium-228. From Table 1 the total radium background is 1pCi/g + 0.87pCi/g, respectively. Added to 5 pCi/g, this would be a cleanup guideline of 6.87 pCi/g for this site. In Table 1, sites GP007 and GP009 exceed this criterion. An actual cleanup level for this site cannot be determined until local background levels for at least radium-226 and radium-228 are measured.

Section 4.2 Literature Review - Data presented in this report does not support the assertion that radioactivity in coal fly ash is comparable to radioactivity in background soils and rocks. Background levels for the primary radionuclides (those in the U-238 and Th-232 decay series) are about 1 pCi/g (Table 5) while measured levels in the GP004 – GP013 data (Table 4) are about 2 – 7 times this. If this GP data is considered to be from coal combustion products then there is a definite elevation over background as shown in the attached Table 1.

Table 1 – Background Data and Data for Sites GP004 through GP013

	U-238 Decay Series (pCi/g)						Th-232 Decay Series (pCi/g)				U-235 Decay Series					
	U-238	U-234	Th-230	Ra-226	Pb-210	Po-210	Th-232	Ra-228	Th-228	Ra-226 + Ra-228 (pCi/g)	U-235	Pa-231	Ac-227	U-NAT	U-238	U-235
Background Table 6	0.96	0.96	0.96	1	1	NA	0.87	0.87	0.87	1.87	0.007			2.1	2.1	2.1
GP004	2.53	2.55	2.19	2.19	2.13	2.13	1.59	1.41	1.53	3.6	0.272	0.107	0.0952	6.1	6.1	0.045
GP005	2.86	3.66	3.23	3.23	3.22	3.22	2.56	2.59	2.63	5.82	0.238	-0.642	0.289	10.4	10.4	0.075
GP006	4.14	3.94	3.49	3.49	4.21	4.21	2.85	3	2.92	6.49	0.246	-0.475	-0.0537	11.1	11	0.079
GP007	4.17	4.71	4.22	4.22	5.61	5.61	3.14	2.87	3.21	7.09	0.337	-0.598	0.0474	14	13.9	0.099
GP008	3.1	3.49	3.06	3.08	2.1	2.1	2.28	2.29	2.34	5.35	0.146	0.175	0.0408	14.6	14.5	0.11
GP008	2.2	3.4	3.25	3.25	4.55	4.55	2.37	2.52	2.42	5.77	0.282	-0.637	-0.0341	12.9	12.8	0.093
GP009	4.77	5.38	4.63	4.63	6.81	6.81	2.79	2.63	2.85	7.26	0.347	-0.57	0	14.1	14	0.1
GP010	3.79	3.95	3.4	3.4	2.81	2.81	2.58	2.58	2.85	5.96	0.223	0.298	0.0565	9.8	9.7	0.07
GP011	2.58	2.65	2.43	2.43	2.88	2.88	2.03	2.17	2.07	4.6	0.203	0.442	0.0985	7.4	7.3	0.0561
GP012	2.62	3.68	3.23	3.23	2.27	2.27	2.07	2.12	2.13	5.35	0.267	0.772	0.0479	10.5	10.4	0.075
GP013	2.3	2.06	1.7	1.7	1.55	1.55	1.53	1.49	1.56	3.19	0.0774	-0.205	-0.0503	8.5	8.5	0.06